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Smart grid development in Quebec: A review and policy approach

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ABSTRACT

What explains the inception, the scope and the political saliency of smart grid development? Illustrating the dynamics of non-agenda-setting, this study reviews the electricity sector in the Canadian province of Quebec. Drawing from Kingdon's multiple streams, we argue that the opening of a policy window that would put smart grid development on the policy agenda has proved elusive. In the problem stream, we show that key actors in Quebec's electricity sector do not link smart grid development to policy problems such as climate change or sustainability. In contrast to other jurisdictions, abundant renewable electricity removes the pressure to substitute fossil with renewable energy and the need for its integration via smart grid. In the policy stream, we show that despite the presence of different ideas about smart grid among experts, the state-owned electric utility dominates the policy monopoly and frames smart grid as a technological fix to upgrade the grid. In the political stream, we observe that the issue has very low salience. Based on media analysis, we show that the public mood is somewhat negative and focuses mostly on the health impacts of smart meters. Another factor is the lack of political entrepreneurs emerging either for or against smart grid deployment. As the three streams do not converge and no policy entrepreneur promotes a broad vision of smart grid that would require fundamental changes in the electricity sector, this review concludes that smart grid in Quebec has developed primarily in the form of a technological, security-focused upgrade.

1. Introduction

"Smart grid" is promoted as an innovative tool to change the way societies produce, distribute, and consume electricity. A smart grid is a network that connects generators and consumers to ensure electricity supply that is economically efficient, secure and sustainable. It comprises tangible information and communication technologies (ICT), but it is also used as a proxy for the way electricity demand and supply should be managed to meet different societal objectives. Smart grid is often considered as part of a sustainable energy transition which implies not only technical innovations, but also social, behavioural, institutional and policy adjustments. For its advocates, smart grid is a key element of the sustainable energy transition that aims to mitigate climate change, enhance energy security and prevent soaring energy prices.

While engineers and IT experts have been interested in smart grids for some time, smart grid development is relatively recent in Europe and North America. In Ontario, a rapid deployment strategy for smart meters was launched in 2004 and is considered to be "the furthest evolution of smart grid policy agenda-setting, formulation and implementation in Canada to date" [1]. In this Canadian province, smart grid has been put on the policy agenda as an ambitious strategy to upgrade the grid while mitigating climate change. By contrast, in the neighbouring province of Quebec, smart grid deployment came later, lacked political saliency, and has been limited in scope. In Quebec the primary goals of the smart grid initiative have been to address security and enhance electricity invoicing, with minimal ambitions for more fundamental change to the industry's operating model.

In this paper, we review smart grid development in Quebec by asking why the smart grid policy agenda in Quebec has been so limited, promoted almost exclusively as a security and technical issue. An obvious difference between Ontario and Quebec is that the latter has access to abundant and cheap electricity, while Ontario phased out coal, relies on nuclear and gas power and made important investments in intermittent renewable energy. In addition, Ontario's electricity sector is divided between different utilities while Quebec still has a state monopoly. This review of Quebec's narrower use of smart grid opportunities may help us better understand the mechanisms that explain paths of smart grid development in other jurisdictions, such as Norway and British Columbia, which are dominated by quasi-monopolies, generating abundant, cheap, non-fossil electricity.

To conduct this review and answer our research question, we use

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Kingdon's [2] multiple streams approach, which has been used widely to explain policy change and to analyze when and why issues get attention, how issues are framed, which actors participate in decision-making, and how policy entrepreneurs seek to push their ideas [3,4]. Kingdon argues that ideas float in a kind of "primeval soup". They only stick on the policy agenda when the three streams of *problems*, *policies* and *politics* converge. The coupling of the streams leads to the opening of a policy window, which is the "opportunity for advocates of proposals to push their pet solutions, or to push attention to their special problems" [2].

Using this approach, we argue that the path of smart grid development in Quebec has been narrow and lacked political salience because no policy window has opened for a more expansive, comprehensive smart grid strategy. In the problem stream, we show that key actors in Quebec's electricity sector do not link smart grid development to policy challenges such as climate change or sustainable energy transition. In contrast to other jurisdictions, abundant renewable electricity removes the pressure to substitute "dirty" fossil sources by "green" energy and, thus, to rely on smart grid for its integration. In the policy stream, we show that despite the presence of different ideas on smart grid development among Quebec experts, the state-owned electric utility dominates the policy scene and frames smart grid mainly as a technological fix to upgrade the existing grid; smart meters contribute to rationalize its "business-as-usual" operations. In the political stream, we observe that the issue has low salience. Based on a media analysis, we show that the public discourse about smart grid is somewhat negative and focuses mostly on the potential impacts of smart meters. Low political salience is reinforced by the fact that no significant policy entrepreneurs have emerged either for or against the deployment of smart grid. As the three streams do not converge and no policy entrepreneur promotes a broad vision of smart grid requiring fundamental changes of the electricity system, we conclude that smart grid has developed narrowly and in the form of a technological, security- and invoicing-focused upgrade.

From a theoretical point of view, our results confirm the strength of the policy approach: as Kingdon predicts, there is, in the absence of converging streams, no policy agenda setting. Beyond this finding, this review of the Quebec case helps to refine the dynamics of non-agenda-setting, that is to improve our understanding of why certain policy energy "solutions" may not end up on the policy agenda of certain jurisdictions, while they are salient elsewhere.

2. Smart grids in Quebec

The concept of smart grid has been promoted as an ambitious strategy both to upgrade the electricity infrastructure and to accelerate a sustainable energy transition that is considered indispensable given the growing threat of climate change. Two global policy imperatives have been identified as triggers for the smart energy transition: (1) policies to mitigate CO_2 emissions are required in order to reduce the impact of climate change, and (2) energy security must be enhanced to ensure economic stability, especially for countries that depend on imported fuels [5].

The concept of smart grid regroups different technologies. For example, it includes smart meters that measure generator outputs (supply side) or consumption (demand side) in real time. The smart meter helps the supply manager control loads, but may also help the consumer to control consumption. Other technologies such as sensors and communication networks also belong to the smart grid family [6]. It should be noted that advocates of the smart energy transition imply not only technical innovations and changes, but also social, behavioural and institutional adjustments with regard to, among others, issues of privacy, security, invoicing and access [7,8]. Several US and European jurisdictions have embraced smart grids to decentralize, rationalize, and/or reduce electricity production [9,10]. In Canada, Ontario has been at the forefront of such efforts with the most comprehensive smart grid strategy [1].

Table 1
Summary of ongoing smart grid initiatives in Quebec. Sources: Data adapted from [18] and [19].

Smart grid components	Hydro-Quebec	Hydro-Sherbrooke
Smart meters	Rollout by 2018	
Demand response	Smart zone in Boucherville	Peak shaving Control of electric water & heat
Network monitoring	Smart zone in Boucherville	
Network automation	PARD Programme: deployment of 3 600 automated switches CATVAR: deployment of volt & var on 130 substation	
Transport	Development of charging stations for plug-in electric vehicles Vehicle-to-grid (V2G) Vehicle-to-home (V2H)	

In Quebec, in contrast, smart grid has been limited to operations and security-based applications that are not linked to a larger policy agenda. So far, the most salient smart grid component in the public sphere has been the rollout of smart meters. In 2011, Hydro-Quebec, the state-owned integrated public utility, launched its program to replace 3.75 million traditional meters by a system of remote meter reading [11]. Even if the new infrastructure is conceived as two-way communication, the meters are actually used by Hydro-Quebec to collect usage, voltage and power quality data, but no time-of-use rates have been introduced and consumers cannot monitor and adapt their energy consumption in real time. Table 1 gives an overview of the other smart grid initiatives that are ongoing. These initiatives are about optimizing and securing the grid, improving energy efficiency, reducing CO_2 emissions and testing vehicle-to-grid and vehicle-to-home appliances [12–14]. Hydro-Sherbrooke, the electricity provider of the city of Sherbrooke with about 80,000 clients, also has two smart grid programs related to demand response [15]. Other actors are involved in research initiatives such as the *Smart Energy Research Institute* [16] or *Equation*, a public-private partnership to reduce energy consumption and CO_2 emissions [17].

In sum, smart meters are mainly construed as a means to rationalize and securitize Hydro-Quebec's operations. All other activities are in the realm of technology development and there is no policy agenda, with the possible exception of the sectoral *Electric transport strategy 2013-17,* which promotes electric-powered means of transportation such as electric public transportation, light electric vehicles and solutions for freight transportation [19]. The upgrading of the existing grid and operating activities – optimization and security – is the main objective, in continuation with the established centralized system of supply.

3. A policy approach

What explains the inception, the scope and the political saliency of smart grid development? Given the multiple meanings of smart grid it is not surprising that the literature has put forward different drivers for its development. Based on American and European case studies several factors can be identified: the need to upgrade an obsolete infrastructure [7], the general trend of decentralization due to the integration of more renewable energy into the grid [20], new applications such as electric vehicles and more "intelligent" information and communication technologies [21], or incumbent actors from the ICT sector [22]. European studies have also shown that regulation may be important. According to van Renssen and Belin [23], EU legislation on energy and climate as well as on market liberalization "was probably the catalyst for industry to mobilize 'smart technologies' a few years ago".

Technology-driven explanations are crucial to understand the

development of energy systems, but it is just as important to grasp the dynamics of political agenda setting. Policy studies examine how "issues" are put on the government's policy agenda, how this agenda is turned into public decisions, and whether and how these decisions get implemented. This literature does not assume that "problems" exist "out there" and naturally find an optimal "solution." Rather, it seeks to understand "the dynamics of how new ideas, new policy proposals, and new understandings of problems may or may not be accepted in the political system" [24]. We draw on John Kingdon's multiple streams model, which was first published in 1984, and is the most successful of the policy process approaches according to a recent meta-review [25]. According to Kingdon, ideas, problems, solutions, and participants float around: it is often unclear why certain issues arise on the policy agenda and others do not. In line with Cohen, March and Olsen's model of organizational choice [26], policy-making looks like a garbage can rather than a rational process and evolves around three streams:

1. The *problem* stream is those policy issues seeking attention from decision-makers. Problems are matters of concerns to a critical mass or relevant actors, whereby focussing events and feedback can stress the urgency of problems; issues have thus a much better chance to arise on an agenda if they are perceived as important.
2. The *policy* stream is about the way experts and decision-makers frame solutions (with or without real problems). Policies surface from "the policy primeval soup, [where] many ideas float around, bumping into another, encountering new ideas, and forming combinations and recombinations" [2]. Despite the randomness of the process, criteria such as technical feasibility, public acceptability, or politicians' receptivity make it more likely for some ideas to survive and persist than others.
3. The *politics* stream is about decision-makers motives and opportunities to act on a problem whereby the attention they pay to an issue may depend on the pressure from public opinion or strong interest groups. Political events follow their own logic independently from problem recognition or proposed solutions: elections may change the actor constellation and dominant ideas, or "participants perceive swings in national mood" [2].

These three streams largely follow their own dynamics, but they are sometimes aligned: during these temporary conditions, a window of opportunity opens and the issue is set on the agenda, allowing policy entrepreneurs to create or change policies in major ways. As Howlett [27] has demonstrated within the Canadian context, the opening of policy windows is not random; it tends to be supported by institutional dynamics across the three streams.

The references to Kingdon's model skyrocketed in a wide range of policy areas since the mid-2000 [28]. The model provided also a fruitful ground for numerous case studies on environmental and energy issues. For instance, the model was used to analyze the adoption of acid-rain legislation [29] and sustainable forest management [30]. With regard to climate and energy, it was applied to the transformation of climate and energy policy [31] and to strategies to keep climate change on the policy agenda [32], to climate change related forest policy [33], to emissions trading schemes [34], to mandatory reporting of greenhouse gases rules [35] as well as to the study of feed-in tariffs [36]. It helped analyze carbon capture and storage [37] as well as the development of policy to promote renewable electricity [38].

We use Kingdon's model to analyze the path of smart grid development in Quebec. The Quebec case is interesting because, despite the fact that smart grid development is occurring, it was never really put on the policy agenda defined as "the list of subjects or problems to which governmental officials, and people outside of government closely associated with those officials, are paying some serious attention at any given time" [2]. According to this model one would expect that a similar understanding of smart grid in the three different streams leads to the opening of a policy window, which then allows policy entrepreneurs to formulate and push for a tangible smart grid policy for the electricity sector. If the streams do not converge, however, the idea of smart grid will remain in the primeval soup, i.e. it will remain undeveloped, incoherent, and with low salience in the policy process. In Quebec, the lack of convergence is partly explained by the electricity sector's institutional setup; while occurring because it answers specific operational and technical needs, smart grid development has not been put on the policy agenda.

This case thus provides useful material to analyze what, paraphrasing Bachrach and Baratz's "dynamics of non-decision-making" [39], we call the dynamics of non-agenda-setting. Agenda setting cannot be taken for granted. Even if there is a supply of new technologies and a potential demand for them, there is no guarantee that politics respond to the demand. To understand such cases, it is thus critical to analyze the institutional set-up and the constellation of stakeholders when the use of a technology was not put on the policy agenda.

4. Research strategy and methods

To effectively review and map out the electricity domain in Quebec, our research strategy employs three methods, each with a view to analyzing one of Kingdon's streams: document analysis describes the problems stream, stakeholder interviews identify policy ideas, and media analysis characterizes the politics stream. Put together, these three methods provide a comprehensive picture of the dynamics of non-agenda-setting in the Quebec electricity sector (see Table 2).

4.1. Problem stream

To describe the current situation of the electricity domain, its strengths, constraints, and challenges, we systematically analyze the following official documents: Hydro-Quebec's annual reports (2004–2012), the Quebec government's Energy Strategy 2006–2015, Transportation Electrification Strategy 2013–2017 and Electric Vehicle Action Plan 2011–2020, the 2014 Consultation report by the Commission on Quebec's energy issues, Hydro-Quebec's Sustainable Development Action Plan 2013–2016, briefs filed to the *Régie de l'énergie* in the context of phase 1 of Hydro-Quebec's remote meter reading deployment, and CANMET Energy's reports on smart grids since 2010.

4.2. Policy stream

To identify which policy ideas stakeholders put forward, we completed 16 semi-directive interviews with industry representatives, experts, civil society activists, and electricity providers. The selection of interviewees was based on positional and reputational approaches [40]. Following an interview protocol that was approved by the university's ethical research board, one of the authors conducted, recorded and transcribed all interviews between November 2013 and February 2014. Despite our best efforts, no provincial government representative

Table 2
Three different research methods were applied to explore the three streams.

Kingdon's Stream	Method	Source of Data Analyzed
Problem	Document analysis	Government of Quebec Hydro-Quebec *Régie de l'énergie* CANMET
Policy	Stakeholder interviews	4 from Research & innovation sector 5 from Industry 4 from Civil society 3 from Electric utilities
Politics	Media analysis	*La Presse* *Le Devoir*

agreed to talk to us, referring us to a federal agency instead, which we met. The interviews, lasting between 30 min and 2 h, covered the following topics: the general understanding of smart grids, the drivers of their development, the potential benefits and risks, the key players involved, issues of social acceptance, the market structure, smart grids in the wider context of renewable energy development and sustainability. To structure the stakeholder analysis, we follow Amory Lovins' [41] distinction between visions of centralization and decentralization, which we used to code stakeholders' statements using NVivo 10.0 data analysis software. For some, smart grid supports centralization due to larger interconnected electricity systems and the expansion of long-distance transmission, which allows for distant large-scale electricity generation; for others, smart grid favours decentralized electricity systems with distributed and local electricity generation, controlled by communities [8]. In the coding, we also allowed for third category when the statements on centralization/decentralization were "ambivalent".

4.3. Politics stream

We carried out a media analysis to examine how smart grid issues are framed and perceived in the public sphere. This analysis addresses the level of public awareness, identifies relevant policy actors and their positions, and highlights current trends in the development of smart grid technologies, including risks and benefits. We selected *La Presse* and *Le Devoir*, the two main French-language broadsheet daily newspapers of the province with influential editorial pages. Both are published in Montreal, Quebec's largest city, but have a province-wide circulation. *La Presse*, owned by Power Corporation, is a liberal, business friendly newspaper that leans toward Canadian federalism. *Le Devoir* is an independent newspaper that tends toward social democratic values and Quebec's nationalist movement [42]. Based on keywords, articles were retrieved from the database *Eureka* from 1990 to 2012 and classified in accordance with the methodology developed by Jennie Stephens and her collaborators [43]. We used the NVivo 10.0 data analysis software to code a total of 104 articles (41 from *La Presse*, 63 from *Le Devoir*). As this study is part of a pan-Canadian smart grid media analysis, the codebook was adapted to the Canadian context. Although only one person coded the Quebec data, inter-coder reliability was tested among three coders from different provinces. The NVivo 10.0 coding comparison query resulted in a satisfactory percentage agreement of 95.27% between the coders.[1]

5. Analyzing the three streams

In this section, we use Kingdon's model as a heuristic tool to map out the current state of the electricity domain in Quebec along its problem, policy and political streams, and to identify how the issue of smart grids is apprehended as a problem, as a policy idea, and as a political project.

5.1. The "non-problem" of electricity consumption

The International Energy Agency considers the development of smart grid essential for addressing common problems of energy security, economic development and climate change mitigation. However, these problems are not framed in the same way in different places and they do not appear to have the same urgency everywhere. In what follows we outline the particularities of Quebec's electricity context to explain why there is no push from the problem stream to put smart grid on the policy agenda.

A first reason why there is no problem push is that Quebec has negligible carbon emissions from power generation. The province is the fourth largest hydropower producer in the world with a capacity of 35,829 MW and hydropower amounts to 193.7 TW h (97%) of the total electricity generation [44]. Quebec can be compared with Norway, which has 97.5% of non-fossil electricity production [45], or France with 90% [46]. A second critical element is that electricity is cheap. For political reasons, a "heritage pool" of 165 TW h at a set price of 2.79¢ per kW h was introduced to guarantee low and stable rates across the province, especially for residential consumers. Table 3 shows that Montreal, Quebec's metropolis, benefits from among the cheapest rates among OECD countries.

A final important element to mention is the historical and economic role Hydro-Quebec plays in the French-speaking province. Electricity generation is still perceived by Quebeckers as a key driver for economic development and, thus, for the modernization of state and society [49]. Hydro-Quebec, the key actor of the electricity sector, is in charge of the generation, transmission and distribution of electricity. The public utility contributes significantly to government revenue, as dividends of $2.2 billion in 2014 illustrate [13]. Commercially oriented, Hydro-Quebec dominates the domestic market, even though there are some smaller municipal companies such as Hydro-Sherbrooke. In the recent decades, private wind electricity producers have been allowed to operate throughout the province. These producers must sell all their electricity to Hydro-Quebec that then distributes it. In contrast with most other countries, Quebec promoted wind power mainly for economic development concerns, that is, to support ailing regions [50].

In a nutshell, there is no "problem push" from inside the electricity sector in Quebec to put the smart grid on the policy agenda: first, the cost of hydropower generation is relatively low and electricity prices are comparatively advantageous, so that there is no urgency to use smart grid technology to introduce real-time pricing and to reduce consumers consumption and electricity bills; second, there is no pressure to increase the amount of renewable energy such as wind or solar to reduce carbon emissions given that electricity is almost entirely generated from hydropower; third, high electricity production and high exports mean both high profits for Hydro-Quebec and high dividends for the government. All in all there is no impetus to fundamentally reform the electricity system or change public policy priorities in the electricity sector.

If there is no problem push from inside the sector, could it come from outside? For several decades, Quebec has exported a significant proportion of its electricity to New England, New York and New Brunswick. In recent years, some observers have vaunted energy efficiency as a way to create surpluses and increase exports to these markets. Yet this argument has been made almost entirely to justify tariff hikes, not smart grid investments [51]. And, as an expert interviewee explained, this is premised on the expectation that there

Table 3
Comparison of electricity prices for households in US cents/kW h, 2015. Sources: [47,48].

Region	US cents/kW h	US cents/kW h (using PPP)s[a]
Canada	10.72	10.97
Montreal QC	7.19	–
Vancouver BC	10.29	–
Winnipeg MB	7.95	–
US	12.67	12.67
New York NY	28.90	–
Boston MA	30.03	–
France	17.68	19.35
Norway	9.45	7.77
OECD Europe	21.75	25.89
OECD total	16.31	18.04

[a] Purchasing Power Parities.

[1] For the codebook and interview protocol please contact the authors.

is a hugely lucrative export market out there, which is not necessarily the case because of the lack of interconnections.[2] Another possible problem push could have come from the partial liberalization of the 1990s. This liberalization brought important institutional changes and a more market-driven orientation to Quebec's energy policy sector. In particular, the *Régie de l'énergie* was created and Hydro-Québec was unbundled in to three different units for production, distribution and exports. Later, unbundling made wind power development possible. However, as we will see in the next section, Hydro-Quebec retains a strong policy monopoly, which new actors have a hard time challenging.

5.2. The enduring policy monopoly of the state-owned public utility

We now turn to the "primeval soup" of policy ideas. In Canada energy is a matter of shared jurisdiction: the federal government regulates interprovincial and international trade and commerce and is in charge of non renewable resources on federal lands, whereas provinces have powers over the exploration, development, conservation and management of non renewable resources; likewise, they have jurisdiction over electricity generation [52]. In Quebec's electricity sector, there is a long-standing policy monopoly, led by Hydro-Quebec and backed by both liberal and nationalist governments [53,54]. According to Baumgartner and Jones [55], a policy monopoly is a structural arrangement supported by powerful ideas: the institutional structure is responsible for policymaking and limits access to the policy process. The policy actors holding the policy monopoly seek to promulgate a positive policy image of their public actions and attempt to keep policy elaboration within the established institutional structures of the policy sector.

The policy image of the electricity sector in Quebec dates back to the 1960s. In the context of the so-called Quiet Revolution, the nationalization of electricity was in line with Quebec's strategy to reduce the province's dependence on energy supply from abroad and was perceived as a key leverage for economic development. Understood as a "social contract" between the developing state and its population, nationalization led to a drop in electricity prices for consumers. But more remarkably, the establishment of Hydro-Quebec as a public corporation became a driver for major infrastructure projects (e.g. Churchill Falls, James Bay), and a factor of emancipation and identity for Quebeckers (*Maîtres chez nous – Masters of our own house* – was Premier Jean Lesage's slogan during the 1962 election), which continues to capture the public imagination to this day [56]. Quebec is probably unique in the degree to which its electricity model has been unaffected by the wave of liberalization that engulfed most jurisdictions since the 1990s. Associated with economic development and the emancipation of Francophones, Hydro-Quebec is sometimes considered as a state within the state or, as an interviewee put it "a giant within the giant: you can't tell it what to do… even for the government it's not easy."[3]

Over the years, the policy monopoly has been regularly challenged and new ideas float around: economists from the think tank *The Montreal Economic Institute* called for the privatization of Hydro-Quebec in 2007 [57] and their confreres Luc Godbout et Claude Montmarquette [58] did the same in their 2014 public finance report; the development of wind energy raised controversies about social acceptance and the ownership of wind [50]; the expansion of hydropower has been contested by First Nations and environmental groups such as *Fondation Rivières* [49]; NGOs like *Equiterre* ask for energy efficiency and consumption reduction, and consumer organizations challenge the price increases before the energy regulator. According to Schattschneider [59], the actors holding the policy monopoly seek to confine the scope of conflict and restrict participation of other actors in the policy process, whereas monopoly outsiders try to expand the conflict, to challenge the policy image and to gain the attention of potential allies.

These developments do not evolve in a vacuum, but are path dependent on existing institutional arrangements and infrastructure. As Stephens et al. [8] point out:

> Investment focused on re-orienting the grid toward either of these endpoints reduces the likelihood of achieving the other: if investments are made in local electricity generation, the demand for long-distance transmission lines and centralized generation will be reduced. On the other hand, major investment in long-distance transmission lines and concentrated electricity generation at sites far from demand centers could reduce the need for distributed local generation. Decentralization collides with existing patterns of ownership and control, and given the power and expertise embedded in established institutions that rely on a centralized system, a widespread shift to decentralization may be difficult to secure.

This tension is obvious in the stakeholder analysis. Fig. 1 illustrates the synopsis of all statements with regard to centralization and decentralization that occurred in the interviews. The stakeholders have been grouped in four categories, i.e. Electric utilities, Industry, Research & innovation, and Civil society. The closer you are to the core of the circle, the more you embrace a centralized vision of smart grid development, and vice versa. It stands out that interviewees from *Electric utilities* clearly favour the continuity with the current operating model: they advocate smart grids in a centralized approach to allow for more energy efficiency, and they see no need to develop smart grids to integrate renewable energy from wind or solar; also, micro-generation is of little interest. A utility representative is convinced that low production costs and electricity prices do not encourage other ways of operating: "[…] my personal view on residential clients is that they don't want to embark in dynamic relations with the electric utility. What is important for the client is a reliable service: if I turn on the switch, there is light and it costs as little as possible. With the current [low] electricity prices, it's difficult to think of deploying technologies that would make him participate more".[4]

All other categories of stakeholders are more open to develop smart grids in a decentralized manner. Certain actors from *Industry* show an interest in changing the current operating model and express that smart grids can lead the way to a more decentralized electricity system and micro-grids. Some favour a model where prosumers – consumers, who also produce electricity – generate their own power and feed the excess into the grid. They are, however, sceptical about the willingness of Hydro-Quebec to give a hand to such developments. The idea of prosumers and decentralized, local electricity systems and micro-grids is strongly supported by actors from *Civil society*, but because of the institutional lock-in they are pessimistic about its realization. One interviewee puts it as follows: "[…] I think it's essential to make our grids smarter, but they need to be decentralized. The consumers must have their say about it, and it has to be for the common good. And, it's about this point that we need to debate, but there are no debates. Decisions are taken by Hydro[-Quebec] and they go ahead with one billion dollars. There's no parliamentary commission, no public debate about smart grids".[5]

The most coherent and articulate arguments in favour of smart grid within a decentralized model come from *Research & innovation* stakeholders. They show a strong interest in distributed generation and micro-grid development, where regional companies generate electricity closer to the consumer needs; they are also concerned about

[2] Interview with authors (Research and innovation 1), December 2, 2013.
[3] Interview (Research and innovation 3) with authors, December 19, 2013; our translation.
[4] Interview (Utility 2) with authors, November 15, 2013; our translation.
[5] Interview (Civil society 2) with authors, December 11, 2013; our translation.

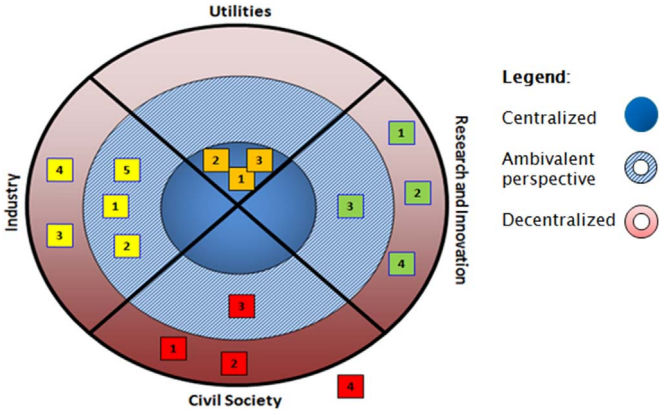
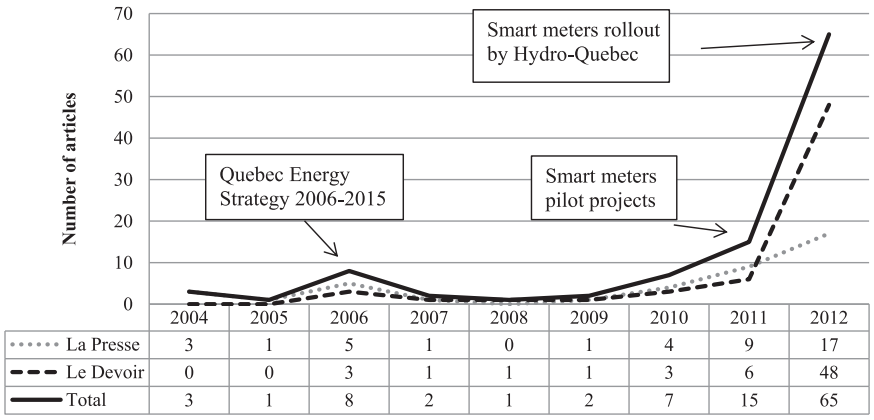


Fig. 1. Degree of centralization vs decentralization in smart grid visions of different Quebec stakeholder groups.



	2004	2005	2006	2007	2008	2009	2010	2011	2012
La Presse	3	1	5	1	0	1	4	9	17
Le Devoir	0	0	3	1	1	1	3	6	48
Total	3	1	8	2	1	2	7	15	65

Fig. 2. Number of Quebec newspaper articles mentioning smart grid 2004–2012. Source: Authors' own calculation based on Eureka.cc

risks related to a centralized infrastructure. As a senior researcher put it: "(...) because of the burdensome, centralized management by Hydro-Quebec we do not use the potential of a better management. What I see is that Hydro-Quebec embarks in the smart grid market in a very centralized manner. In fact, I could very well imagine that regional companies, even municipal ones for big cities like Montreal, would be intermediaries, and because one needs to be in contact with consumers, there is social acceptance, one needs to know the environment. I don't think that Hydro-Quebec needs to know every forgotten corner of Northern Montreal; they probably have a lot of data, they could manage things, but there are no economic incentives".[6]

In sum, interviewed stakeholders have, in general, detailed knowledge about the potential of smart grid technologies, including different ways to optimize and secure the grid and in-depth changes of the electricity system. But no one is in any doubt that Hydro-Quebec is the key actor and that there is institutional and technological lock-in, which limits the leeway for new ideas. Up to now, the electricity monopoly around Hydro-Quebec seems to hold [60]. And it uses its key position to frame smart grid mainly as a technological fix to update the existing grid, make it safer, and improve invoicing.

6. The politics of invisibility

Finally, we look at the politics stream that flows independently from the problem and the policy streams. It encompasses variables related to power relations, but also the public mood, that is the attitude of organized groups and the public with regards to the electricity sector in general, and smart grids issues in particular. Since the 1980s, the politics of electricity in Quebec have remained largely dominated by the question of big dam projects [49]. In recent years, there was a significant debate about wind energy development and social acceptance [50]. But, as mentioned above, changes of government have not affected the policy monopoly in the electricity sector.

In the media analysis, the frequency and placement of newspaper articles suggest that the smart grid and smart meter deployments get growing media attention in Quebec, even though the absolute numbers remain low (Fig. 2). Thus, compared to dams or wind, the issue of smart grids has very low salience. While there is no single occurrence related to smart grids in the print media from 1990 to 2003, the media start to cover smart grids in 2004 at a low total of three articles published in *La Presse*. In 2006, the newspapers issued eight articles about smart grids or smart meters, focusing mainly on the *Quebec Energy Strategy 2006–2015*. Media attention increased significantly from 2010 to 2012, stimulated by smart meter pilot projects in three regions of Quebec in 2011 and the smart meter rollout in 2012, which triggered a debate about the risks and benefits of smart meters (Fig. 2).

La Presse has the highest coverage of smart grids and related technologies from 2004 to 2011 (total of 24 articles), while *Le Devoir* published almost three times more articles than *La Presse* in 2012 (48 articles for *Le Devoir*; 17 for *La Presse*). Louis-Gilles Francoeur, environmental journalist at *Le Devoir* at the time, took a particular interest in the smart meter rollout and potential health risks associated with radiofrequencies. In 2012, he edited 28 smart grid related articles, which explains the high coverage by *Le Devoir*.

The component of smart grid that gets the most media attention is undoubtedly the smart meter (Fig. 3). Its ongoing rollout has been dominant in the public discourse around smart grids in Quebec. Only 13 articles mentioned smart grids in general, while 91 articles focused on

[6] Interview (Research & Innovation) with authors, December 2, 2013; our translation.

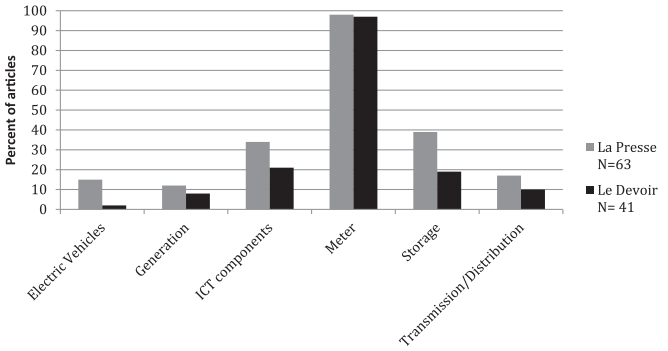


Fig. 3. Frequency of smart grid technologies mentioned in Quebec newspaper articles. Source: Authors' own calculation.

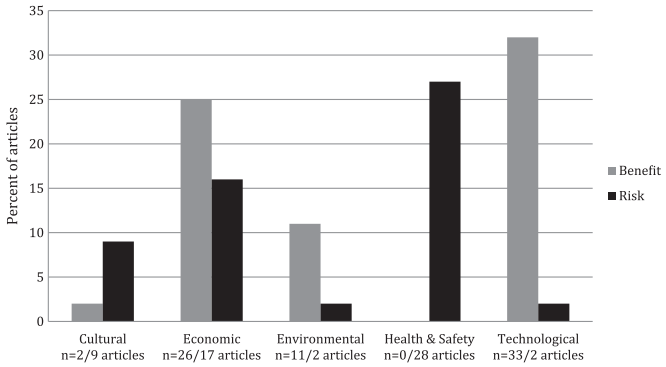


Fig. 4. Distribution of mentions of smart grid risks and benefits in Quebec media discourse. Source: Authors' own calculation.

smart meters in particular. In addition, only three of the 104 articles we analyzed did not refer to smart meters. The preeminence of smart meters, covered by 97% of the analyzed articles, is also obvious when we consider the media attention put on the different smart grid components. As Fig. 3 shows, "other components" also get some minor attention: electric vehicles (15% of *La Presse* articles; 2% of *Le Devoir* articles), ICT components (34% *La Presse*; 21% *Le Devoir*), storage (39% *La Presse*; 19% *Le Devoir*), transmission and distribution (17% *La Presse*; 10% *Le Devoir*) and generation (12% *La Presse; 8% Le Devoir*). Overall, smart grid components have a broader coverage in *La Presse* than in *Le Devoir*.

In what terms are smart grid initiatives framed in the newspapers? The only activities mentioned are related to smart meters. Negative statements on smart meters initiatives in Quebec significantly exceed positive ones: more than half of all the newspaper articles display a negative point of view about smart meter initiatives in Quebec, compared to 19% of articles with a positive description. Likewise, negative statements are found in 12% of the articles about Quebec pilot programs, compared to 3% that contain a positive frame. Overall, the negative smart meter coverage exceeds the positive in both newspapers. In order to get a better sense of what underlies these negative and positive statements on smart grids and meters, we qualified the articles in terms of different benefits and risks: cultural, economic, environmental, health and safety and technological. Table 4 typifies the meaning of these different categories using a classification scheme adapted from Jennie Stephens and her collaborators [43].

Finally, Fig. 4 shows the aggregated picture on risks and benefits from both newspapers. On the one hand, smart grid and related technologies are presented as technologically, economically and environmentally beneficial. It is interesting to note that, overall, smart grids and meters are framed more often in terms of economic and technological benefits in the more business friendly *La Presse* than in *Le Devoir*. On the other hand, these technologies are framed in terms of health and safety risks and, to a lesser degree, of cultural risks (privacy concerns). Also, smart grid is framed in terms of economic risks (concerns of cost overruns in smart meter rollout), but to a lesser extent than economic benefits. The health and safety risks remain clearly the most important issue of the public debate: the fear of radiofrequencies emitted by smart meters mobilized different actors – established environmental organizations, but also new grassroots movements at the community level – against the rollout of smart meters in province.

To sum up, media discourse about smart grid is mainly focussed on smart meters and the "public mood" is somewhat negative, i.e. concerned with impacts on health. However, the overall salience is low, and no significant political entrepreneur has emerged either for or against the deployment of smart grids. Environmental NGOs, which came out in support of wind power projects and can mobilize large numbers against pipeline projects, have not adopted strong positions on smart grid. The provincial government, which funds many of these organizations, has not tried to co-opt them in the same way that it did through climate change or wind power initiatives. Not surprisingly, no political party has campaigned or even adopted a position on smart grid. Those who do think about smart grid tend to have a negative opinion, but they are only loosely organized. Politically, smart grid is a non-issue.

7. Conclusion

Among international energy experts there is great interest in the potential of smart grid to fundamentally reform our electricity systems and to trigger a sustainable energy transition, a transition that not only involves technical innovation, but also supposes social, behavioural, institutional, and policy innovation. This review demonstrates that while technological change is underway in Quebec, there is little sign of these other kinds of changes. Relying on Kingdon's multiple streams, we showed that no policy window opened up for ambitious smart grid development in Quebec. First, there was no "problem" push and no incentive to reform the electricity sector in Quebec. Hydro-Quebec and its single shareholder, the Quebec government, benefit from high electricity production and exports, so reducing consumption via smart grid might negatively impact incomes. Also, there is no call for cleaner or cheaper electricity sources in the province. Second, the actor that would have the power to set the policy agenda, Hydro-Quebec, has focused on smart grid as a technological and security fix to upgrade and secure the existing grid; there is no incentive to change "business as

Table 4
Qualification in terms of risks and benefits. Source: Adapted from [43].

	Risks	Benefits
Culture	Cyberattacks, threats to privacy, social injustice (marginalisation of poor and elderly people)	Better knowledge of consumption and electricity prices, behavioural change, better consumption patterns
Economics	Increase of electricity prices, cost overrun, job loss	Energy efficiency, job creation, financial savings
Environment	Increase of waste, increase of CO_2 emissions and air pollution	Reduction of CO_2 emissions and air pollution, energy conservation, reduction of peak demand, integration of renewable energy
Health/security	Increase of health problems due to radiofrequency	Security of supply, reduction of health problems
Technology	Unreliability of technology, rapid technological obsolescence	Optimization of the electricity infrastructure, better real-time response, more reliable electricity system

usual". Despite partial liberalization, there are no policy entrepreneurs who could seriously challenge the actual policy monopoly and the government, as the key actor of this policy monopoly, is quasi absent from the smart grid discussion. Finally, smart grid has low salience in the public space; even though the public mood seems to be somewhat negative with regard to smart meters, there is no critical mass to put the issue on the political agenda. In the absence of a policy window, the inception of smart grid development was late, narrow in scope and with little political salience.

The three streams conceptualized by Kingdon have not converged in this case: there is no push in the problem stream; a technological upgrade, but no policy impetus in the policy stream; and negative voices, but no leverage in the political stream. The Quebec case of smart grid development thus provides an illustration of the dynamics of non-agenda-setting. As we have seen, the institutional setup of the electricity sector around hydropower and the public utility's policy monopoly explains why smart meters emerged as the main vehicle to promote the smart grid concept while other smart grid components never made it to the policy agenda. The non-agenda-setting confirms Kingdon's insight that a convergence of the three streams is necessary to trigger the policy process. It also highlights the importance of studying the impact of politics on the adoption of new energy technologies.

This argument about the dynamics of non-agenda-setting could be tested on other jurisdictions whose institutional set-up are similar to that of Quebec, such as France and Norway, or other Canadian hydropower provinces such as British Columbia or Manitoba. These jurisdictions also rely on abundant non-fossil and relatively cheap energy, either hydro or nuclear. This means that the climate change and economic imperatives to reduce energy consumption are weaker than in most countries. Despite some liberalization over the past 20 years, they also all display the legacy of commercially oriented, integrated quasi-monopolies with strong connections to the state. Comparing these other cases with this review of Quebec could shed further light on the interplay of energy system development and political factors.

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